

Claims

That which is claimed:

- 5 1. A phase changeable memory device, comprising:
a substrate;
a lower electrode disposed on the substrate;
a phase changeable pattern disposed on the lower electrode; and
an upper electrode disposed on the phase changeable pattern and having a tip that
10 extends therefrom and is directed toward the lower electrode.
2. The phase changeable memory device of Claim 1, further comprising:
an interlayer insulating film disposed on the substrate having an opening therein
that exposes at least a portion of the lower electrode; and
15 wherein the phase changeable pattern is formed in the opening and has a
depression therein that is directed toward the lower electrode.
3. The phase changeable memory device of Claim 2, further comprising:
spacers disposed between opposing sidewalls of the interlayer insulating film and
20 the phase changeable pattern in the opening.
4. The phase changeable memory device of Claim 2, further comprising:
an etch stop layer disposed between the interlayer insulating film and the lower
electrode.

5. The phase changeable memory device of Claim 1, further comprising:
a shield layer that is disposed on sidewalls of the phase changeable pattern and the upper electrode.

5 6. A phase changeable memory device, comprising:
a substrate;
a lower electrode disposed on the substrate;
an interlayer insulating film disposed on the substrate having an opening therein
that exposes at least a portion of the lower electrode;
10 a spacer pattern disposed on sidewalls of the opening;
a phase changeable pattern disposed on the lower electrode in the opening and
extending on the interlayer insulating film; and
an upper electrode disposed on the phase changeable pattern and having a tip that
extends therefrom and is directed toward the lower electrode.

15 7. The phase changeable memory device of Claim 6, wherein the phase
changeable pattern has a depression therein that is directed toward the lower electrode.

8. The phase changeable memory device of Claim 6, further comprising:
20 a shield layer that is disposed on sidewalls of the phase changeable pattern and the
upper electrode.

9. The phase changeable memory device of Claim 6, further comprising:
an etch stop layer disposed between the interlayer insulating film and the lower
25 electrode.

10. The phase changeable memory device of Claim 6, further comprising:
a plate electrode that is electrically connected to the upper electrode.

5 11. A phase changeable memory device, comprising:
a substrate;
a lower electrode disposed on the substrate;
an interlayer insulating film disposed on the substrate having an opening therein
that exposes at least a portion of the lower electrode;
10 a spacer pattern disposed on sidewalls of the opening;
a phase changeable pattern disposed on the lower electrode in the opening; and
an upper electrode disposed on the phase changeable pattern and extending on the
interlayer insulating film, the upper electrode having a tip that extends therefrom and is
directed toward the lower electrode.

15 12. The phase changeable memory device of Claim 11, wherein the phase
changeable pattern has a depression therein that is directed toward the lower electrode.

20 13. The phase changeable memory device of Claim 11, further comprising:
an etch stop layer disposed between the interlayer insulating film and the lower
electrode.

14. The phase changeable memory device of Claim 11, further comprising:
a plate electrode that is electrically connected to the upper electrode.

15. A method of forming a phase changeable memory device, comprising:
providing a substrate;
forming a lower electrode disposed on the substrate;
forming a phase changeable pattern on the lower electrode; and
5 forming an upper electrode on the phase changeable pattern that has a tip that
extends therefrom and is directed toward the lower electrode.

16. The method of Claim 15, further comprising:
forming an interlayer insulating film on the substrate that has an opening therein
10 that exposes at least a portion of the lower electrode; and
wherein forming the phase changeable pattern comprises forming the phase
changeable pattern in the opening so as to have a depression therein that is directed toward
the lower electrode.

15 17. The method of Claim 16, further comprising:
forming spacers between opposing sidewalls of the interlayer insulating film and
the phase changeable pattern in the opening.

18. The method of Claim 16, further comprising:
20 forming an etch stop layer between the interlayer insulating film and the lower
electrode.

19. The method of Claim 15, further comprising:
forming a shield layer on sidewalls of the phase changeable pattern and the upper
25 electrode.

20. A method of forming a phase changeable memory device, comprising:
providing a substrate;

forming a lower electrode on the substrate;

5 forming an interlayer insulating film on the substrate that has an opening therein
that exposes at least a portion of the lower electrode;

forming a spacer pattern on sidewalls of the opening;

forming a phase changeable pattern on the lower electrode in the opening and
extending on the interlayer insulating film; and

10 forming an upper electrode on the phase changeable pattern that has a tip that
extends therefrom and is directed toward the lower electrode.

21. The method of Claim 20, wherein the phase changeable pattern has a
depression therein that is directed toward the lower electrode.

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22. The method of Claim 20, further comprising:

forming a shield layer on sidewalls of the phase changeable pattern and the upper
electrode.

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23. The method of Claim 20, further comprising:

forming an etch stop layer between the interlayer insulating film and the lower
electrode.

24. The method of Claim 20, further comprising:

25 forming a plate electrode that is electrically connected to the upper electrode.

25. A method of forming a phase changeable memory device, comprising:
providing a substrate;

forming a lower electrode on the substrate;

5 forming an interlayer insulating film on the substrate that has an opening therein
that exposes at least a portion of the lower electrode;

forming a spacer pattern on sidewalls of the opening;

forming a phase changeable pattern on the lower electrode in the opening; and

forming an upper electrode on the phase changeable pattern and extending on the
10 interlayer insulating film, the upper electrode having a tip that extends therefrom and is
directed toward the lower electrode.

26. The method of Claim 25, wherein the phase changeable pattern has a
depression therein that is directed toward the lower electrode.

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27. The method of Claim 25, wherein the phase changeable pattern has a
depression therein that is directed toward the lower electrode.

28. The method of Claim 25, further comprising:

20 forming an etch stop layer between the interlayer insulating film and the lower
electrode.

29. The method of Claim 25, further comprising:

forming a plate electrode that is electrically connected to the upper electrode.

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30. A method of forming a phase changeable memory device, comprising:

providing a substrate;

forming a lower electrode on the substrate;

forming an interlayer insulating film on the lower electrode and the substrate;

5 patterning the interlayer insulating film to form a contact hole that exposes at least a portion of the lower electrode;

forming a spacer pattern on sidewalls of the contact hole;

forming a phase changeable material layer in the contact hole on the lower electrode, the phase changeable material layer having a depression therein that is directed
10 toward the lower electrode;

forming a conductive film on the phase changeable material layer; and

patterning the conductive film and the phase changeable material layer to form an upper electrode and a phase changeable pattern, respectively.

15 31. The method of Claim 30, further comprising:

forming an etch stop layer on the substrate and the lower electrode prior to forming the interlayer insulating film.

20 32. The method of Claim 31, wherein patterning the interlayer insulating film comprises:

patterning the interlayer insulating film to expose the etch stop layer on a portion of the lower electrode; and

etching the exposed etch stop layer to expose the lower electrode.

25 33. The method of Claim 30, wherein the phase changeable material layer is

thicker than half of a minimum width of a lower portion of the contact hole.

34. The method of Claim 30, wherein the conductive film fills the depression of the phase changeable material layer to form a tip directed toward the lower electrode.

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35. The method of Claim 30, further comprising:

forming an upper interlayer insulating film on the upper electrode;

patterning the upper interlayer insulating film to expose a portion of the upper electrode; and

10 forming a plate electrode on the upper interlayer insulating film that is connected to the exposed portion of the upper electrode.

36. The method of Claim 35, further comprising forming a shield layer on the upper electrode and sidewalls of the phase changeable pattern prior to forming the upper
15 interlayer insulating film.

37. A method of forming a phase changeable memory device, comprising:

providing a substrate;

forming a lower electrode on the substrate;

20 forming an interlayer insulating film on the lower electrode and the substrate;

patterning the interlayer insulating film to form a contact hole that exposes at least a portion of the lower electrode;

forming a spacer pattern on sidewalls of the contact hole;

forming a phase changeable pattern in the contact hole on the lower electrode, the
25 phase changeable pattern having a depression therein that is directed toward the lower

electrode;

forming a conductive film on the phase changeable material layer; and
patterning the conductive film to form an upper electrode.

5 38. The method of Claim 37, further comprising:
forming an etch stop layer on the substrate and the lower electrode prior to
forming the interlayer insulating film.

 39. The method of Claim 38, wherein patterning the interlayer insulating film
10 comprises:
patterning the interlayer insulating film to expose the etch stop layer on a portion
of the lower electrode; and
etching the exposed etch stop layer to expose the lower electrode.

15 40. The method of Claim 37, wherein forming the phase changeable pattern
comprises:
forming a phase changeable material layer in the contact hole on the lower
electrode, the phase changeable material layer having a depression therein that is directed
toward the lower electrode such that a deepest point of the depression is located below an
20 upper surface of the interlayer insulating film; and
chemical mechanical polishing the phase changeable material layer to expose the
interlayer insulating film to form the phase changeable pattern.

 41. The method of Claim 37, wherein the conductive film fills the depression
25 of the phase changeable material layer to form a tip directed toward the lower electrode.

42. The method of Claim 37, further comprising:

forming an upper interlayer insulating film on the upper electrode;

patterning the upper interlayer insulating film to expose a portion of the upper

5 electrode; and

forming a plate electrode on the upper interlayer insulating film that is connected
to the exposed portion of the upper electrode.

43. The method of Claim 42, further comprising forming a shield layer on the

10 upper electrode and sidewalls of the phase changeable pattern prior to forming the upper
interlayer insulating film.